Environmentally Acceptable Chemical Strippers

Background:

The Aerospace National Emissions Standards for Hazardous Air Pollutants (NESHAP), adopted on September 1, 1995, and effective three years from publication, enacted public law severely limiting the use of methylene chloride at all aerospace manufacturing and reworking facilities. In addition, methylene chloride is on the Environmental Protection agency (EPA) 17 and Air Force Material Command (AFMC) 24 lists of hazardous materials targeted for reduction. As a result of these regulations, the options to the USAF were to replace methylene chloride with environmentally acceptable (EA) chemical strippers, to use dry media blasting (DMB), or to capture the HAPs via control or recovery devices.

The Air Force uses chemical strippers in the depaint process to remove the coating systems from some aircraft. The chemical strippers in use contain high concentrations of volatile organic compounds (VOC). Future environmental trends are leading to decreasing the amount of VOCs emitted thus necessitating the implementation of control/recovery devices or the use of compliant (chemical) strippers.

In the interim period between the NESHAP's adoption and the date for demonstration of compliance (1995 - 1998), considerable effort was done by the Air Logistic Centers (ALC) to enable the facilities to operate in full compliance and productivity. Acceptable chemical stripping types and methods are described in Air Force technical order T.O.1-1-8. These chemical strippers were evaluated and accepted based upon a Purchase Description (PD) written by WR-ALC. However, the implications of compliance affect OC-ALC significantly as it exclusively uses chemical strippers to depaint aircraft. OC-ALC felt that WR-ALC's PD did not adequately address their needs. Therefore, OC-ALC developed their own PD incorporating the issues and acceptance levels that they considered critical.

As a result, the two PDs differ in their requirements for corrosion (immersion and dissimilar metal), hydrogen embrittlement, various chemical and physical properties, test panel preparation, and chemical stripper effectiveness evaluation. The Coatings Technology Integration Office (CTIO), having been directed and funded by AFMC/CEV, is resolving the discrepancies between the two PDs and will consolidate them into one.

As this process reaches fruition, the extent of the discrepancy and the validity of the test methods and ranges of the consolidated PD may need to be explored.

The effectiveness of the EA chemical strippers, separate from the discontinuity between the two PDs, has been questioned. An EA chemical stripper accepted and considered highly effective by one ALC failed miserably at another ALC, despite being evaluated supposedly on the same coating system. It was later learned the environmental conditions at the second installation had detrimentally affected the effectiveness of the chemical stripper. This disparity would have been avoided if the effectiveness of the chemical stripper in question had been evaluated in a consistent manner i.e. accounting for the possible variations in the environmental conditions at the ALCs. Unfortunately, a guideline for testing the effectiveness of a chemical stripper did not exist at the time.

Absent from both of these PDs is the range of environmental conditions over which the chemical strippers can be used effectively. As the formulations for the chemical strippers become more mature and varied in nature, re-occurrences of similar problems are probable; hence, the need for this project.

Project Sponsor/Customer: WR-ALC, OC-ALC, SM-ALC
Period of Performance: Sep 96 - May 01

Objective:

The overall objective of this project is to facilitate the integration of promising environmentally acceptable chemical strippers into production. The expected outcome will be a general guideline for specifying the range of experimental conditions that need to be evaluated in order to determine the effectiveness of a new environmentally acceptable chemical stripper based on its chemical stripper type.

Currently, the various specifications and PDs for EA chemical strippers tend to focus on distinguishing types of coating rather than types of chemical strippers. When the chemical strippers were categorized, it was based on application instead of function. As the technical requirements of the chemical strippers are consolidated, vendors will be able to formulate and produce products to meet the specifications. Also, future environmental restrictions will need to be incorporated into vendors' consideration of ingredients i.e., to accommodate lower VOC allowances. For maximum efficiency, the specifications need to be designed so as to be able to adjust to range of variation of mechanisms of chemical strippers.

Requests have been received from WR-ALC, OC-ALC, and SM-ALC for assistance in integration of EA chemical strippers. The EA Chemical Stripper Integration Project proposes to facilitate integration of promising EA chemical strippers through the refinement and application of evaluation procedures developed in a CTIO FY97 project. In order to design a method to integrate promising EA chemical strippers, a protocol for evaluating the integration must first be assessed.

The Project includes the following four tasks:

1. Develop an accelerated curing schedule to produce test panels having coatings with chemical and mechanical properties similar to aircraft at the end of their PDM cycle.
2. Develop a method of applying the chemical stripper and removing the paint to allow quantification.
3. Develop a classification system for chemical strippers based on components and mechanisms accompanied by a guideline for the classification of future chemical strippers
4. Within each classification, identify the critical performance parameters. The magnitude of impact on chemical stripper effectiveness will be determined as a function of stripper classification for a simple coating system.

Status:

A series of experiments were performed at the CTIO Laboratory to determine the evaporation and diffusion rates of several benzyl alcohol based paint strippers at a series of temperatures and humidities. The goal of these experiments was to provide data for a predictive model that could utilize experimental diffusivity and solvent activity data taken at a small set of controlled conditions to predict solvent concentration profiles in the stripper, primer and overcoat. This knowledge could then be used to predict the overall effectiveness of a stripper at a given set of conditions. Processing and interpretation of this data indicated this approach would not be adequate due to the complexity of the materials (stripper, multi-layer paint structure, etc.) and phenomena controlling the stripping process. Project results are being documented.

The CTIO staff is combining the two purchase descriptions into one PD. The draft PD was distributed to AF organizations for comments. The comments are being reviewed and resolved with the AF users. A completed single PD is expected this fall.

Project Plan: Phase 1 dated Feb 98, Phase 2 dated Jan 00,
Test Plan: Lab Test Plan 1 dated Mar 00, Lab Test Plan 2 dated Mar 00
Final Report: Completion planned for spring 01
As of Date: Project status as of Apr 01